SUPPORT STRUCTURE WITH FOLDABLE END CAP

BACKGROUND OF THE INVENTION

1. Field of the invention.

The present invention relates to portable support structures for use in temporary or permanent stands or displays, such as trade shows and conventions, and particularly to a portable truss assembly having a foldable end cap connecting planar wall elements.

2. Description of Related Art.

Commercial displays such as those used in trade show booths require strong structures that can be easily transported and configured in a wide variety of forms. Such structures need to be lightweight, portable, and able to be quickly set up and broken down.

Prior display structures have contained folding elements that utilize rigid wall members coupled with rotatable wall members. The rotatable wall members allow the display to collapse. The displays include other pivoting members that serve to lock the assembly into an open position. Although useful in some applications, this approach has deficiencies. The need for numerous differently configured rigid and rotatable members increases the inventory of parts, thereby making assembly more complicated and expensive. Further, the pivoting members may not provide a significant locking force to provide sufficient structural stiffness in some applications.

It can be seen that there is a need for a collapsible/foldable truss assembly that is strong, easily fabricated and assembled into a temporary or permanent structure. The present invention fulfills these and other needs, and addresses other deficiencies of prior art implementations.

SUMMARY OF THE INVENTION

To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the present invention discloses a portable support structure adapted for use in temporary or permanent stands or displays. The portable truss assembly disclosed herein has a foldable end cap that connects planar wall elements.

An apparatus in accordance with the principles of the present invention includes a foldable truss assembly including a plurality of wall members. The wall members having a first and second receiving member, each receiving member capable of receiving an attachment member of at least one foldable end cap. The foldable end cap including a plurality of adjacently connected elongated arm members, each arm member having a first and second end and an interface surface. The foldable end cap also including a plurality of hinge members, each hinge member being pivotally disposed between the first end of each arm member and the second end of an adjacent arm member. The arm members are connected by the hinge members forming a closed loop. The interface surfaces of each arm member facing the interface surface of the adjacent arm member. A folding plane is defined by the interface surfaces of the arm members. The foldable end cap also includes a plurality of attachment members disposed at an intersection of the first end of each arm member and the second end of the adjacent arm member. The attachment members substantially perpendicular to the folding plane. The foldable end cap also

including a locking mechanism fixedly attachable between at least two arm members. The locking mechanism preventing relative rotation between an arm member and an adjacent arm member.

Other embodiments of a system in accordance with the principles of the present invention may include alternative or optional additional aspects. One such aspect of the present invention is that each of the arm members also include an outer surface opposite the interface surface and a first and second access void being disposed interiorly of the first and second ends and a portion of the attachment member being disposed within the access void.

Another aspect of the present invention is that each of the arm members also include a first and second pivot hole on the interface surface at the first and second ends. The hinge members are disposed about a first pivot hole of a first arm member and a second pivot hole of an adjacent arm member.

Another aspect of the present invention is that the locking mechanism also includes two elongated pivot bars each having a pivot end, a locking end and a pivot member at the pivot end. The pivot members of the pivot bars are rotatably coupled to the end cap at diagonally opposite hinge members. The locking mechanism also includes a locking member attachable to the locking ends of the pivot bars. The attached locking member preventing relative longitudinal displacement of the pivot bars. The elongated pivot bars are rotatable about the pivot members. The pivot bars are rotatable so that the locking ends of the pivot bars are movable into relative proximity.

Another aspect of the present invention is that the hinge members also include a flat bushing between interface surfaces of adjacent arm members.

Another aspect of the present invention is that the attachment members protrude from a side of the end cap.

Another aspect of the present invention is that the attachment members protrude from two sides of the end cap.

Another aspect of the present invention is that the wall members include two elongated support members and a cross member fixedly connected between the support members.

Another aspect of the present invention is that the truss assembly also includes a cross bar removably attachable between one of the support members of one wall member and one of the support members of another wall member.

Another aspect of the present invention is that the at least one end cap comprises two end caps. The plurality of wall members having a first and second receiving member at opposing ends of the wall member and the attachment members of the two end caps are received into the receiving members on opposing ends of the wall members.

Another apparatus in accordance with the principles of the present invention includes a foldable truss assembly including a plurality of wall members having a first and second receiving member, each receiving member capable of receiving an attachment member of a foldable end cap. The foldable end cap including a plurality of adjacently connected elongated arm members, each arm member having a first and second end and an interface surface. The foldable

end cap also includes a plurality of attachment members, each attachment member pivotally disposed between the first end of each arm member and the second end of each adjacent arm member. The arm members are connected by the attachment members forming a closed loop. The interface surfaces of each arm member facing the interface surface of each adjacent arm member. A folding plane is defined by the interface surfaces of the arm members. The attachment members protruding from the end cap substantially perpendicular to an interface plane. The foldable end cap also includes a locking mechanism rotatably attached between diagonally disposed attachment members. The locking mechanism preventing relative rotation between an arm member and an adjacent arm member.

Another aspect of the present invention is that each of the arm members also includes an outer surface opposite the interface surface and a first and second access void disposed on an interior of the first and second ends. A portion of the attachment member is disposed within and extends from the access void.

Another aspect of the present invention is that each of the arm members also includes a first and second pivot hole on the interface surface at the first and second ends. The attachment members passing through the first pivot hole of a first arm member and the second pivot hole of an adjacent arm member.

Another aspect of the present invention is that the locking mechanism also including two elongated pivot bars each having a pivot end, a locking end and a pivot member at the pivot end. The pivot members of the pivot bars are rotatably

coupled to the end cap at diagonally opposite attachment members. The locking mechanism also includes a locking member attachable to the locking ends of the pivot bars. The attached locking member preventing relative longitudinal displacement of the pivot bars. The elongated pivot bars are rotatable about the pivot members and the pivot bars are rotatable so that the locking ends of the pivot bars are adjustable into relative proximity.

Another aspect of the present invention is that the attachment members also include a flat bushing between interface surfaces of adjacent arm members.

Another aspect of the present invention is that the attachment members protrude from two sides of the end cap.

Another aspect of the present invention is that the wall members include two elongated support members and a cross member fixedly connected between the support members.

Another aspect of the present invention is that the truss assembly also includes a cross beam removably attachable between a support member of a first wall member and a support member of a second wall member.

Another aspect of the present invention is that the at least one end cap includes two end caps. The plurality of wall members each have a first and second receiving member at opposing ends of the wall member and the two end caps are receivable into the receiving members on opposing ends of the wall members.

A method in accordance with the principles of the present invention includes a method of assembling a foldable truss member. The method including

unfolding an end cap. The end cap including a plurality of arm members having first and second ends. The arm members are adjacently connected forming a closed loop. The first end of each arm member is pivotally connected to the second end of each adjacent arm member, each arm member also including an attachment member at first and second ends. The method also including attaching a plurality of wall members each having at least two receiving members to the end cap. The receiving members of the wall members are connected to at least two of the attachment members of the end cap. The method also includes pivoting a first and second pivot bar, each pivot bar having a locking end and pivotally coupled to the first end of one of the arm members. The pivoting of the pivot bars moves the locking ends of the pivot bars into relative proximity. The method also includes attaching a locking member to the proximate locking ends of the pivot bars to connect the pivot bars and prevent relative longitudinal motion of the pivot bars.

Another aspect of the present invention is that the method also includes attaching a cross beam between two of the wall members to stabilize the wall members.

The foregoing objects, advantages and distinctions of the invention, among others, are obtained in a presently preferred construction that provides a truss assembly having a foldable end cap connecting planar wall elements.

These and various other advantages and features of novelty which characterize the invention are pointed out with particularity in the claims annexed hereto and form a part hereof. However, for a better understanding of the

invention, its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to accompanying descriptive matter, in which there are illustrated and described specific examples of an apparatus in accordance with the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

Fig. 1 illustrates a perspective view of a foldable end cap according to an embodiment of the present invention;

Fig. 2 illustrates an end view of a foldable end cap demonstrating folding of the end cap according to an embodiment of the present invention;

Fig. 3 illustrates an end view of a foldable end cap in a completely folded configuration according to an embodiment of the present invention;

Fig. 4 illustrates a perspective view of a foldable truss assembly according to an embodiment of the present invention;

Fig. 5 illustrates a perspective view of a foldable end cap showing a locking device according to an embodiment of the present invention;

Fig. 6 illustrates a partial cutaway view of a coupling member according to an embodiment of the present invention;

Fig. 7 illustrates a cutaway view of a coupling member according to an embodiment of the present invention;

Fig. 8 illustrates a side view of a coupling member as shown in Fig. 7 according to an embodiment of the present invention;

Fig. 9 illustrates a cutaway view corresponding to section 1-1 of Fig. 1 showing a hinge member according to an embodiment of the present invention; and

Fig. 10 illustrates a cutaway view corresponding to section 1-1 of Fig. 1 showing a hinge member according to another embodiment of the present invention.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail herein. It is to be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the invention is intended to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the claims appended hereto.

DETAILED DESCRIPTION OF THE VARIOUS EMBODIMENTS

In the following description of the illustrated embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration, various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized, and structural and functional changes may be made without departing from the scope of the present invention.

The present invention provides a portable support structure adapted for use in temporary or permanent stands or displays. The portable truss assembly is provided with a foldable end cap that connects planar wall elements.

Fig. 1 illustrates a perspective view of a foldable end cap according to an embodiment of the present invention. In Fig. 1, a foldable end cap 100 includes a plurality of elongated arm members 102. The arm members 102 are adjacently connected such that a first end of a first arm member 102 is pivotally connected to a second end of a second arm member 102. In this way, the arm members 102 are joined to form a closed loop shape (e.g. rectangle, square or variable parallelogram). Hinge members 104 are located at the intersection of adjacent arm members 102. Interface surfaces 108 are defined on an outer surface of the arm members 102 where each arm member 102 adjoins an adjacent arm member 102. The interface surfaces 108 define a folding plane 109. The interface surfaces 108 remain generally in the folding plane 109 when the end cap 100 is folded. Attachment members 106 protrude generally perpendicular to the folding plane 109, and can protrude from one or both sides of the end cap

100. Although the end cap 100 has been shown with the arm members overlapping in Fig. 1, the arm members may be joined in a flush mount or end-to-end swiveling configuration. The hinge assembly shown in Fig. 1 may also be replaced with a swiveling mechanism as desired.

Fig. 2 illustrates the end cap 100 being moved into a folded configuration. The arm members 102 are rotated about the hinge members 104 in the direction indicated by the curved arrows. Fig. 3 shows the end cap 100 in the fully folded configuration. In this configuration, the end cap 100 requires minimum storage space and is more easily transport or stored.

The end cap 100 may be used as part of a truss assembly 400 as illustrated in Fig. 4. The truss assembly 400 may include end caps 100 that are adapted to be coupled to a pair of wall members 402. Attaching end caps 100 to both the top and bottom of the wall members 402 creates a truss assembly 400 capable of supporting vertical loads. The wall members 402 include support beams 404 and cross members 406 that are formed and configured into a generally planar structure. The support beams 404 are typically formed of an elongated, tubular material. In this example, the support beams 404 are illustrated as round tubes, although other cross sectional shapes (e.g. rectangular, triangular, oval, L-shape) may be used. A solid (i.e. non-tubular) support beam 404 may be used as well. The support beams 404 and cross members 406 may be fabricated from metal, composite materials, plastic, corrugated cardboard, or other materials as may be desirable.

The cross members 406 are fixedly attached to the support beams 404, typically by welding. A preferred cross member structure includes a wire lace as shown, but cross braces 410 may be bolted, welded, or attached with other desirable attaching means. The cross braces 410 may be fabricated from metal, composite materials, plastic, corrugated cardboard, or other materials as may be desirable. The support beams 404 may include receiving members 408 (in this embodiment an opening or recess in the end of the support beam 404) adapted for receiving and connecting to the attachment members 106 of the end caps 100. Additionally, locking features (not shown) such as pins, latches, clamps and other devices may be used to positively fix the end caps 100 to the receiving members 408. The end caps 100 may remain attached to the wall members 402 during breakdown and setup of the truss assembly 400, thereby greatly simplifying deployment.

To provide additional stability and safeguard against buckling in special installations with extraordinary loads, a pair of removable cross braces 410 may be attached between the wall members 402. It is appreciated that, if the cross braces 410 are rotatably attached to the support beams 404, then the truss assembly 400, as illustrated in Fig 4, can still be folded, as indicated in Figs. 2 and 3.

A lock mechanism 500 may be utilized to ensure the truss assembly 400 is not foldable after installation. Fig. 5 illustrates a lock mechanism 500 installed on end cap 100. It is appreciated that alternate mechanisms may be used to prevent rotation of the arm members 102, such as set screws, latches, locking

pins insertable through arm member apertures, and other attaching means (not shown). The lock mechanism 500 of Fig. 5 includes pivot bars 502 coupled to pivot members 504 at outer pivot ends 505 of the pivot bars 502. The lower end of the right arm member 102 is cut away to show the deployment of the pivot member 504 between the arm members 102. A pivot attachment member 506 is included and/or integral with the hinge member 104 and allows rotation of the pivot bars 502. A coupling member 508 couples inner pivot ends 509 of the pivot bars 502 to prevent relative longitudinal motion between the pivot bars 502. When the pivot bars 502 are secured by coupling member 508, the lock mechanism 500 acts as a rigid diagonal stabilizing member that prevents folding of the end cap 100. Without the lock mechanism 500 secured, the end cap 100 may be foldable into a variable angle, parallelogram shape.

Fig. 6 shows an embodiment of the coupling member 508. The coupling member 508 includes an outer case 602 that is attached to a threaded cap 604. The outer case 602 includes a mounting hole 606 that is locatable over a right pivot bar 502, as shown in Fig. 6. A pair of clips 608 can be fitted in grooves on the right pivot bar 502 to prevent longitudinal movement of the outer case 602 while allowing axial rotation of the outer case 602. The threaded cap 604 is fixedly coupled to the outer case 602 after the outer case is installed on one pivot bar 502. The left pivot bar 502 includes a threaded section 610 that connects with a threaded hole 612 in the threaded cap 604. By using a threaded interface, the illustrated arrangement may be adjusted to account for variability of pivot bar lengths resulting from manufacturing tolerances in the assembly. The outer

surface of the threaded cap 604 and/or outer case 602 may include a knurled outer surface, allowing the coupling member 508 to be installed or removed without tools.

An alternate embodiment of a coupling member 508 is shown in Fig. 7. Fig. 7 illustrates a cutaway view of the pivot bars 502 (seen here as hollow tubes) and coupling member 508. The coupling member 508 includes pivot protrusions 702 and locking protrusions 704 that are adapted to fit within respective pivot and locking holes 706, 708 in the pivot bars 502. As seen in the side view of Fig. 8, the coupling member includes a lifting handle 802 that allows the coupling member 508 to be rotated about the pivot protrusions 702 disposed in pivot holes 706. The locking protrusions 704 are designed such that they can be snapped in and out of the locking holes 708, thereby providing a quick and easy locking mechanism 500 for engagement/disengagement of the pivot bars 502 from the end caps and truss assembly.

Turning now to details of the hinge members 104 and attachment members 106. Fig. 9 illustrates a cutaway view corresponding to section 1-1 in Fig. 1. In this embodiment, the hinge and attachments members 104, 106 are formed from a single elongated post 902. The post 902 includes features (e.g. grooves) for receiving locking rings 903. The post 902 is disposed in and protrudes from access voids 908 located on the outer surfaces of the wall members 102. The post 902 passes through pivot holes 906 in each wall member 102. A bushing 904 may be disposed on the post 902 and between interface surfaces 108 of the arm members 102. Bushing 904 provides a bearing

surface that allows smooth relative rotation between adjacent arm members 102. After assembly of bushing 904, post 902, and arm members 102, the locking rings 903 may be installed on the post 902 via the access voids 908 in the arm members 102. The locking rings 903 provide mechanical connection of arm members 102 and attachment members 106 while allowing relative rotation of the arm members 102.

Fig. 10 is another cutaway view corresponding to section 1-1 in Fig. 1. In Fig. 10, an alternate embodiment of the hinge members 104 and attachment members 106 is illustrated. The attachment members 106 in this embodiment are hollow tubular members fixedly attached (e.g. welded) to the arm members 102. The attachment members 106 include outward facing open ends 1002. The arm member connection includes a flat bushing 904 positioned between adjacent arm members 102. The hinge member 104 includes a pair of flanged bushings 1004 and a fastener assembly 1006. The fastener assembly 1006 includes a standard bolt, locknut and washer assembly. The fastener assembly 1006 is accessible through the open ends of the attachment members 106 for ease of assembly/disassembly. Although, a standard bolt, locknut, and washer assembly has been shown, other attaching means may be utilized as desirable.

The end cap 100 and truss assembly 400 according to the present invention may beneficially be adapted for all manner of structural uses, including those of a temporary or seasonal nature. One such configuration desirable for uses such as commercial displays or point of sale fixtures is described herein in detail. A truss assembly 400 having approximately 12"x12" cross sectional

dimensions is preferable in these applications. The end cap 100 is formed from ¾ " to 1" square steel tubing joined at the corner by attachment members 106 formed of round steel pipe sections approximately ¾" in diameter. The lengths of the side walls 402 can vary from about 6" to about 46". The support members 404 are formed from ¾ " to 1" round steel tubing welded to 3/16" wire lacing forming the cross members 406. While the various sections of the end cap are illustrated as square tubing sections and the truss assembly sections are illustrated as round tubes, other cross sectional shapes (e.g. rectangular, triangular, oval, L-shape) and combinations thereof may be used. The individual sections may be solid, non-tubular or hollow and be fabricated.

Fabricating the truss assembly 400 from steel offers advantages of low cost, high strength, and magnetic properties for easy attachment of magnetic graphics. The steel is typically powder coated for appearance and corrosion resistance. The weight of the truss assembly 400 can range from ½ pound to 10 lbs for truss lengths between 6" and 46".

In general, the strength of the coupled truss assembly 400 in this application should be able to be safely used in a vertically loaded application where low cost is desired. The open space between wall members 402 (i.e. that space shown spanned by the cross brace 410 in Fig. 4) can be used for attaching shelving and other accessories, while the wall members 402 maintain flat surfaces that provide strong support and may also be used to attach graphics.

Because the end cap is hinged and capable of swiveling motion at corners thereof, the end cap may remain attached to the truss assembly during assembly and disassembly for storage and shipping or may optional be removed. Leaving the end cap attached speeds up the assembly and disassembly process while removing the end cap increases the number of units that can be stored saving storage space.

The foregoing objects, advantages and distinctions of the invention, among others, are obtained in a presently preferred construction that provides portable support structures for use in temporary or permanent stands or displays, such as trade shows and conventions, and particularly to a portable truss assembly having a foldable end cap connecting planar wall elements.

The foregoing description of the exemplary embodiment of the invention has been present for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not with this detailed description, but rather by the claims appended hereto.